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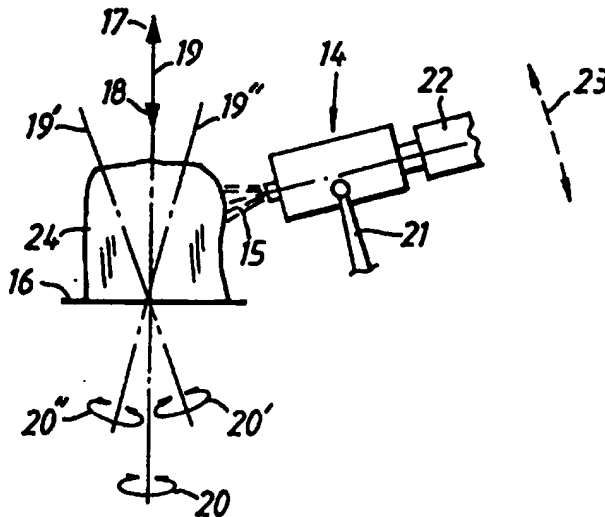
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(21) International Application Number: PCT/SE95/01130 (22) International Filing Date: 3 October 1995 (03.10.95) (30) Priority Data: 9403346-1 4 October 1994 (04.10.94) SE (71) Applicant (for all designated States except US): NOBEL-PHARMA AB [SE/SE]; P.O. Box 5190, S-402 26 Göteborg (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): PERSSON, Magnus [SE/SE]; Åkervägen 4, S-462 61 Vänersborg (SE). (74) Agent: OLSSON, Gunnar; Nobelpharma AB, P.O. Box 5190, S-402 26 Göteborg (SE).		(81) Designated States: AU, CA, FI, JP, NO, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  Published With international search report. In English translation (filed in Swedish).

(54) Title: METHOD AND DEVICE FOR MANUFACTURE OF A DENTAL PRODUCT, AND PRODUCT MANUFACTURED USING THE METHOD AND THE DEVICE

(57) Abstract

A dental cap consists of a substructure made of tissue-compatible material. The substructure (26) is intended to support one or more ceramic onlays (28). The substructure is coated with a plasma layer (27) compatible with the material of the substructure, and with the material of each ceramic onlay applied to the substructure, for the purpose of facilitating application of the onlay material (28) for a customer who has ordered the product.



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## TITLE

Method and device for manufacture of a dental product,  
and product manufactured using the method and the device.

## TECHNICAL FIELD

5           The present invention relates to a method for  
manufacture of a dental product, or product which can be  
used in the human body, being designed with a sub-  
structure made of titanium or equivalent tissue-  
compatible material, which substructure is intended to be  
10   coated with ceramic onlay material (porcelain). The  
method in this case includes information transfer, pre-  
ferably via the telecommunications network, from a  
client. The information can include data on the construc-  
tion of the product. The method also includes the manu-  
15   facture of the said substructure at the production site,  
as well as the transfer or return of the product to the  
coating site for the ceramic onlay material or to the  
client, respectively. The invention also relates to a  
device for facilitating application of ceramic onlay  
20   material onto a product which is made of titanium or  
equivalent tissue-compatible material and intended for  
dental or bodily purposes. The invention furthermore  
relates to a product for use in a dental or other bodily  
context. A possible example of a product is a dental cap.  
25   The product comprises a substructure which is made of  
titanium or another tissue-compatible material and which  
is intended to support one or more ceramic onlays.

## STATE OF THE ART

          It is already known to use a transmission medium,  
30   for example the public telephone network, to transfer  
digital information on the construction of various dental  
products. With the aid of the information transfer, a  
dentist, dental technician, etc., can in this case  
request a machining site to produce a given dental  
35   product. It is thus already known to produce dental caps,  
dental bridge parts, etc., centrally, these being made of

titanium or another tissue-compatible material. The production, which generally implies milling of titanium material, is relatively complicated and requires complex technology which may not be available to the particular client. The product in question can in this case be regarded as a semi-finished product and will be returned to the client for further handling. For example, the client will coat the product in question with a ceramic material which forms an onlay which corresponds to a tooth replacement or the like.

The information to the central machining site in this case consists of an information loop which can comprise machining data, address data for sender and recipient, desired delivery date, etc.

It is already known, in the case of implants which are intended to become incorporated in the dentine, to provide the implant with a thin plasma layer of ceramic material, which is intended to facilitate the incorporation of the implant into the dentine. It is thus already known to use plasma spray installations in conjunction with implants of this type.

## DESCRIPTION OF THE INVENTION

### TECHNICAL PROBLEM

Applying onlay material (ceramic) onto a product substructure which has been produced in this way is a relatively complicated procedure. The application is effected in different layers. It is difficult to get the porcelain or the ceramic to attach to the titanium, among other reasons because it is necessary to work at relatively low temperatures. The invention aims to solve this problem and proposes a method and device and also a product allowing the application of the onlay material to be considerably simplified for the customer and client.

There is also a problem in achieving an aesthetic covering of the substructure when applying the porcelain. The titanium is dark and shows through the onlay material, especially if the latter is to be coated in a thin layer. The invention also solves this problem.

## SOLUTION

The feature which can principally be regarded as being characteristic of the novel method is that the information transfer includes implementation of data concerning the fact that the substructure or the product is to be coated with one or more plasma layers compatible with the material of the substructure/product. The production site in question is in this case equipped with a station in which the said plasma layers can be applied by means of a plasma application installation which is activated as a function of the said data.

Further developments of the method are evident from the attached subclaims relating to the method.

A device according to the invention can principally be regarded as being characterized in that it comprises support members for the product, and plasma application members for applying a plasma layer to the product. Also included is equipment which initiates reciprocal movements between the support member/product and the plasma installation. The said equipment can be activated using activation information, and when such activation information is supplied to the equipment, coating of one or more plasma layers onto the said substructure takes place.

Further developments of the said device are evident from the attached subclaims relating to the device.

The feature which can principally be regarded as characterizing a product according to the invention is that the said substructure is coated with a plasma layer compatible with the material of the substructure, and with the material of each ceramic onlay applied to the substructure, for the purpose of facilitating application of the onlay material for a customer or client who has ordered the product. In one embodiment, the plasma layer can have a thickness of approximately 200 micrometres. The plasma layer is applied on those parts which do not interact with the dentine or corresponding part of the human body.

## ADVANTAGES

By means of what has been proposed above, controlled, thin plasma layers can be obtained on the respective product. The plasma layer material is preferably of a colour which does not show through the onlay material. The layer in question considerably facilitates the application of the onlay material. Equipment which is known per se can be used for the plasma layer application. The application of the plasma layer can take place at temperatures which are considerably higher than the fusion temperature or the phase transition temperature of the titanium. Plasma-sprayable ceramics which are known per se can be used on condition that they are compatible with the titanium material and with the onlay material. Aesthetically advantageous onlays can be obtained for or by the customer or the client in a much simpler way than has hitherto been possible. By means of the invention, the previous manual handling during the application of onlay material can be considerably reduced and simplified. Uncertainty in the application procedure can be eliminated. One advantage is that the plasma layer application takes place centrally, since expensive and relatively complicated equipment has to be used. It is also of advantage to arrange the application operation at a site where a large number of products can be processed.

## DESCRIPTION OF THE FIGURES

A presently proposed embodiment of the method, device and product having the characteristic features of the invention will be described hereinbelow, at the same time with reference to the attached drawings in which:

Figure 1 shows, in diagram form, an information loop or an information packet relating to an order for production of an identified product,

Figure 2 shows, in block diagram form, information transfer via a telecommunications medium to a central unit which receives the production information and includes a station for milling

of the product and a station for plasma layer application to the product or a part thereof, Figure 3 shows, in a side view, parts of the plasma layer application equipment in conjunction with a product, in the form of a dental cap substructure, arranged on a rotating platform, and Figure 4 shows a vertical cross-section of a product with onlay material applied.

#### 10 DETAILED EMBODIMENT

In Figure 1, reference 1 shows an information loop which is made up of different parts A, B, C and D. The information contains data A on the addressee, for example a central production unit. Also included is data B on the client, the desired delivery date, etc. In accordance with the present invention, an information section C is also included, concerning whether the product or part thereof is to be coated with a plasma layer according to what is stated below. The data in space C can in this case include the thickness of the plasma layer, the colour of the plasma layer, the number of plasma layers, etc. There is also included, in a manner known per se, an information section D which includes production data for the product in question. The information can be digital and can consist of "ones" and "noughts" in a manner known per se.

According to Figure 2, a number of customers 2, 3 and 4 can use a telephone network, for example the public telephone network 5, to communicate with a producer 6 or production location. The telecommunications system can in this case operate with so-called packet transmission of a type known per se, in which information from each client is transported via combinable packets to the producer 6. The customers have, in a manner known per se, modems which are used during the transfer, and the production station or equivalent has members 7 which can extract and identify the information items from the customers 2, 3, 4 in a manner which is likewise known per

se. In accordance with the concept of the invention, the production location can include one or more stations 8 for milling of products or product parts in a manner known per se. The information distinguished in the unit 5 7 is received in a unit 9 for generating guidance coordinates which are used in conjunction with the machining or production of the product. The machining and the manufacture of the product, for example a dental cap, can be carried out in a manner known per se and will 10 therefore not be described in any detail here. According to the invention, the product or product part manufactured in each production station will be coated with a plasma layer, in accordance with what is stated below, if information C (see Figure 1) is present in connection 15 with the order. The information according to C is distinguished in the unit 7 and is received in a unit 10 which generates guidance coordinates and/or guidance information for a plasma layer coating installation 11 which can be arranged in connection with the production station or 20 the production stations 8 or can be separate from these. In Figure 2, the information concerning the actual production itself is indicated by  $i_1$ , while milling coordinates which have been compiled are represented by  $i_2$ . In a corresponding manner, the information C emanat- 25 ing from the unit 7 is indicated by  $i_3$ , while the machining function from the unit 10 has the designation  $i_4$ . The total information input to the production unit is indicated by  $i_5$ , which thus includes data according to A, B, C and D. Address information relating to the client is 30 stored in a unit 12, and the address information is represented by  $i_6$ . Products manufactured in stations 8 and 11 are thus addressed in the unit 12. The products are then returned 13 to the ~~persons~~ clients 2, 3 and 4, or to the location specified by each client, for building up the products with onlay material. The order 35 information from the clients is indicated by  $i_5'$ ,  $i_5''$  and  $i_5'''$ .

Figure 3 shows equipment 14 for spraying on plasma layers. The equipment 14 can be of a type known



per se and operates using the known plasma application principle. Starting material being sprayed on is indicated by 15. The product in question, which has been manufactured in accordance with the above at the station or stations 8, is set up on a support platform 16, for example a rotating platform. The platform 16 can be of the type which can be raised and lowered in the directions of the arrows 17 and 18. The longitudinal axis of the rotating platform is indicated by 19. The rotating platform can in this case be of the type where the platform is tiltable, i.e. the longitudinal axis 19 assumes different directions 19', 19'', etc. The rotational movements of the platform are indicated by 20, 20' and 20'', respectively. Alternatively, or in addition, the plasma spray device can be arranged in a fixed or movable manner. A bearing arrangement is indicated by 21, and a ceramic or powder container by 22. Tilting movements of the equipment are indicated by broken-line arrows 23. A product placed on the platform is shown by 24. The rotating platform can be rotated at a speed which can lie between 100 and 500 revolutions per minute. The plasma spray equipment can in this case operate with a material delivery 15 which gives one or more applied layers of 100 to 300, preferably approximately 200, micrometres in thickness. Rotations, upward and downward movements, and any movements of the assembly 14 can in this case take place simultaneously.

Figure 4 shows a tooth replacement or crown indicated by 25. The tooth replacement comprises a product 26 which is manufactured at the station or stations 8 in accordance with the above. The product or the substructure 26 has a spray-coated plasma layer 27 which has been shown in a greatly enlarged form for the sake of clarity. Onlay material 28 of a type known per se is applied on top of the layer. 27 represents a controlled layer of ceramic which is known per se, for example alumina. Alternatively, the layer can consist of a mixture of ceramics. The layer can be grey, for example, and covers the material surface/titanium surface

of the substructure 26. The layer 27 has a coefficient of thermal expansion which is compatible both with the substructure material 26 and with the onlay material 28, which too can be made up of ceramics which are known per se. In addition to the fact that the application of the material 28 is considerably simplified, the dark surface of the substructure 26 is eliminated with the aid of the grey or differently coloured layer 27. The application of the layer 27 can take place at several hundred degrees or at a temperature considerably above the fusion temperature of the material/titanium of the substructure 26. In the spray installation, the material 27 is present in powder form, which can be purchased in the open market. The application thus takes place in a separate production stage. The plasma-sprayable ceramic is sprayed through a hot arc in a manner which is known per se.

Preferably, the equipment at the stations 8 and 11 is in the main completely automated.

The invention is not limited to the embodiment shown hereinabove by way of example, and can instead be subjected to modifications within the scope of the following patent claims and the inventive concept.

## PATENT CLAIMS

1. Method for manufacture of a dental product (26, 27), or product which can be used in the human body, being designed with a substructure made of titanium or  
5 equivalent tissue-compatible material, which substructure is intended to be coated with ceramic onlay material (porcelain) (28), the method including transfer of information (i<sub>5</sub>), preferably via the tele-communications network (5) from a client (2, 3, 4), concerning the  
10 construction of the product, and manufacture of the said substructure (26) at the production site (6), as well as the transfer or return, of the product to the coating site for the ceramic onlay material or to the client, respectively, characterized in that the information  
15 transfer (1) includes implementation of data (C) concerning the fact that the substructure or the product is to be coated with one or more plasma layers (27) compatible with the material of the substructure/product, and in that the production site is equipped with a  
20 station (11) in which the said plasma layers are applied by means of a plasma application installation (14) which is activated as a function of the said data.

2. Method according to Patent Claim 1, characterized in that, upon activation (i<sub>4</sub>), rapid reciprocal movements  
25 (17, 18, 20) are initiated between the product and the plasma application installation (14) which can consist of a plasma spray installation in which the product is rotated and optionally pivoted and the plasma spray member is stationary, or the product is stationary and  
30 the plasma spray member is rotated and optionally pivoted, with each applied plasma layer assuming a thickness of 100 to 300, preferably approximately 200, micrometres.

3. Method according to Patent Claim 1 or 2, characterized in that the information transfer (1) is  
35 initiated in one or more packeting frames in the tele-communications system (5), and in that the production site (6) is provided with modem and extraction member (7)

in which are distinguished production data (D), plasma application data (C), such as layers and colour, and also address data (A, B) from the client.

4. Method according to any one of the preceding  
5 patent claims, characterized in that the production equipment (8) and the plasma application equipment (14) are completely automated in the main.

5. Device for facilitating application of ceramic  
10 onlay material (28) onto a product which is made of titanium or equivalent tissue-compatible material and intended for dental or bodily purposes, characterized in that it comprises a support member (16) for the product (24) and a plasma application member (14) for applying a  
15 plasma layer (27) to the product, in that reciprocal movements (17, 18, 20) between the support member/product and equipment (10) initiating the plasma application members are arranged to be activated by activation information ( $i_4$ ), and in that when activation information ( $i_4$ ) appears, coating of one or more plasma layers on the  
20 substructure (26) of the product takes place.

6. Device according to Patent Claim 5, characterized in that it includes, in addition to a support member for the product, a plasma spray installation (14).

7. Device according to Patent Claim 6, characterized  
25 in that the support member (16) is rotatable and/or pivotable, and the plasma spray installation (14) is stationary in relation to the support member.

8. Device according to Patent Claim 5, 6 or 7,  
30 characterized in that the speed of rotation of the rotatable support member (16) is 100-500 revolutions per minute, and in that the material delivery from the plasma spray equipment is selected to give a finished applied layer of 100 to 300, preferably approximately 200, micrometres.

35 9. Product for use in a dental or other bodily context, for example a dental cap (24), and comprising a substructure (26) which is made of titanium or another tissue-compatible material and which is intended to support one or more ceramic onlays (28), characterized in

that the substructure is coated with a plasma layer (27) compatible with the material of the substructure, and with the material of each ceramic onlay applied to the substructure, for the purpose of facilitating application  
5 of the onlay material (28) for a customer (2, 3, 4) who has ordered the product.

10. Product according to Patent Claim 9, characterized in that the plasma layer is applied on parts which cannot interact with, or are not situated in,  
10 the dentine, and it has a thickness of 100 to 300, preferably approximately 200, micrometres.

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Fig. 1

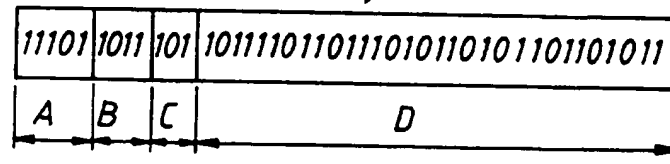
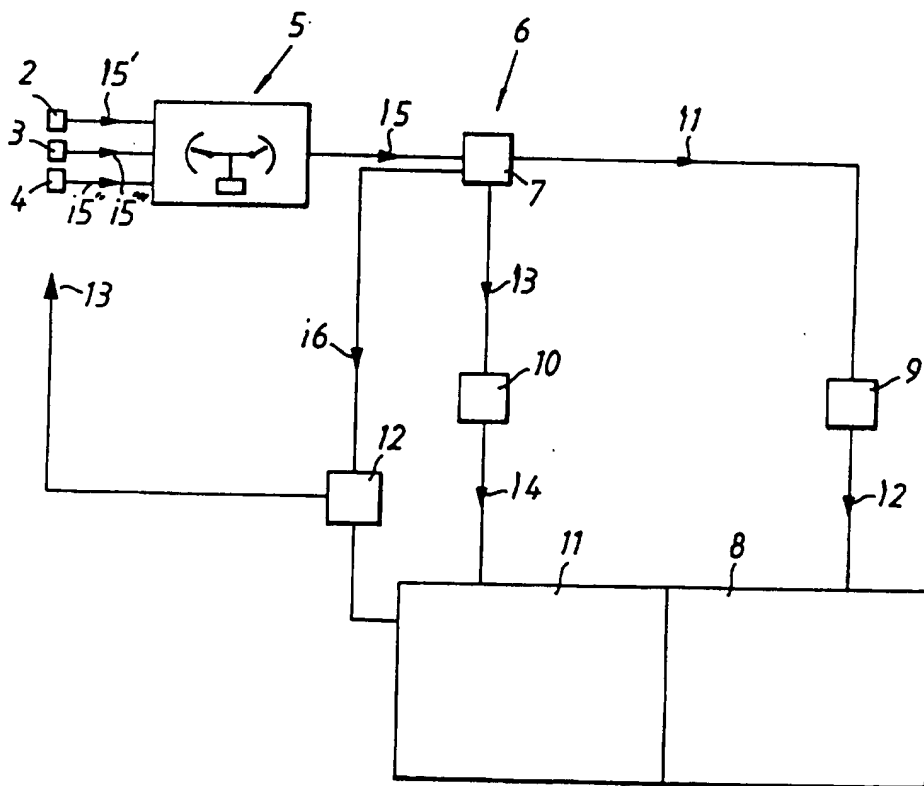


Fig. 2



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Fig. 3

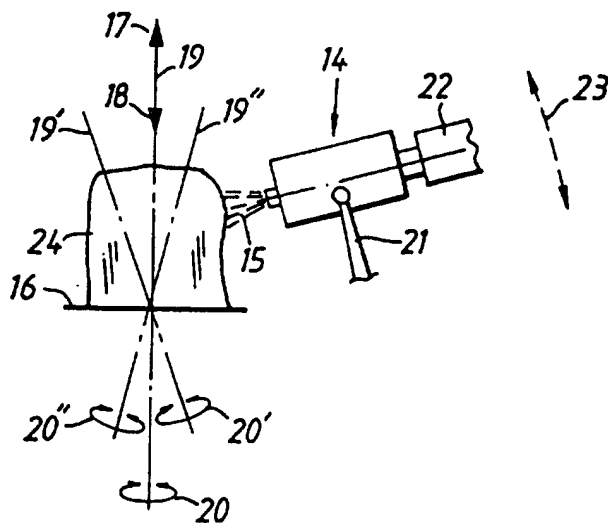
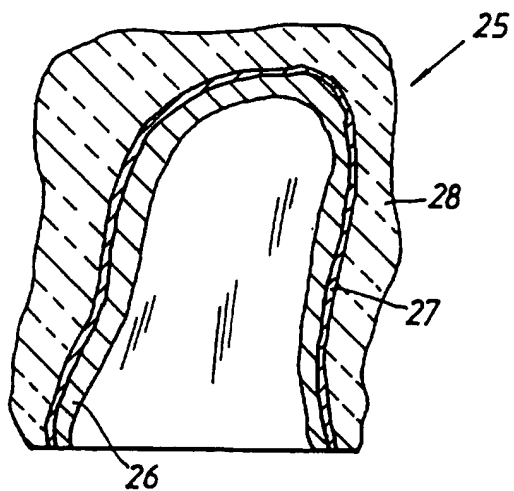


Fig. 4



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 95/01130

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61C 13/00

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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0490848 A2 (NOBELPHARMA AB), 17 June 1992 (17.06.92)	1-8
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A	EP 0548365 A1 (KABUSHIKI KAISYA ADVANCE), 30 June 1993 (30.06.93)	1-8
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Information on patent family members

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International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0490848	17/06/92	JP-A- 5053632	05/03/93
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